MP MASTER
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SYSTRON DONNER

Kruse Electronics

PRELIMINARY INSTRUCTION MANUAL

KRUSE ELECTRONICS

Model 520
Multiband Signal Source

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SECTION I

INTRODUCTION AND DESCRIPTION

The Kruse Electronics Model 520 Multiband Signal Source provides operation and control voltages for up to four standard 5000 series RF plug-ins or up to two double-wide plug-ins on a combination of both.

Control of all functions is accomplished through a rear panel multipin connector. Additional connectors route control to a slave unit and an eight channel Multiplexer/Leveler/Attenuator (Model 522).

The Model 520 may either be used as a stand-alone source or combined with the Model 521 Multiband Controller and Model 522 Multiplexer as a complete compact programmable multiband Sweeper/Generator.

As a stand-alone unit, the 520 offers digital plug-in selection, RF blanking and quieting and analog AM markers, tuning and external AM inputs. A digital "unleveled" output is available. To facilitate common leveling, a stable D. C. leveling amplifier is incorporated which feeds front panel leveling output jacks through individual potentiometers. Adding a Model 522 Multiplexer provides digital attenuation control and a broad band common leveling detector. Plus and minus 20 volts are available for external programming.

The four plug-ins have D. C. voltages applied at all times eliminating initial drift when switching plug-ins and a switching speed determined by the coaxial switches in the multiplexer. For special purposes such as multiple sources or if-offset measurements, multiple plug-ins may be operated simultaneously with individual AM and tuning inputs. When used with the Model 521 Multiband controller, all AM functions such as blanking, squarewave modulation, power control, retrace blanking and marker control are furnished remotely so that individual manipulation of plug-in panel controls is unnecessary.

Long-term instrument reliability is assured by the all solid-state design. No vacuum tubes are used. The Model 520 will provide years of troublefree service without maintenance. It is a permanently calibrated unit. Silicon semiconductors, precision wirewound and metal film resistors, and glass epoxy circuit boards are used. In addition, the conservative design assures an instrument which is well protected against degredation and misuse.

MODEL 520 MULTI-BAND SIGNAL SOURCE

SPECIFICATIONS

USEABLE SOURCES:
All 5000 Series Single and Double-Wide RF Oscillator Plug-Ins.

R.F. SPECIFICATIONS:
See Plug-In Specifications

INTERNAL LEVELING AMPLIFIER:
Precision operational D.C. amplifier accepts leveling detector input from multiplexer or external detector and feeds plug-in leveling inputs through individual level calibration potentiometers.

GAIN:	0.4-1.4 individually adjustable
OFFSET:	∠ ± 1 mV
BANDWIDTH:	300 KHz

EXTERNAL PROGRAMMING: REMOTE IN

Plug-in Select: Eight lines actuated by contact closure or TTL negative logic level. Non-selected plug-ins are blanked to max. attenuation of internal AM modulators (typically ∠40 dB).

Frequency Programming: Eight individual inputs (4 for master, 4 for slave) allow individual tuning control. Zero volts gives lowest frequency, -10 volts gives highest frequency.

RF Amplitude: Eight individual inputs permit external AM control of each plug-in, relative to panel RF level control setting. Sensitivity is 10V pk to pk for full AM range (typically ∠40 dB in unleveled mode) and IV/MW in leveled mode. Positive going increases RF output. Input impendance is ∠ 1 meg ohm.

FM "Quieting": Terminal common to all plug-ins, simultaneously selects frequency control response for 0 to 2 Hz (typical) or 0 to 10 KHz. Zero volts gives 10 KHz response; +5 volts input gives approximately 2 Hz response. Input impedance is 1 K ohm.

SPECIFICATIONS Cont't

Markers: Common control on all plug-ins permits reduction in RF output level with application of a 0 to -1 volt pulse. Input impedance is 100 K ohm. Disabled when plug-in RF level control is set to zero.

Blanking: Common control on all plug-ins permits blanking of set RF level on all "on" plug-ins. Zero volts input gives the unblanked condition; +4 volts input blanks, RF is blanked at maximum attenuation of plug-in AM modulator, typically>40 db below full output. Input impendance 100 K ohm. Does not effect RF amplitude programming input.

Leveling Input: In "Slave" mode of operation, connects to calibration potentimeters and leveling output jacks of all plug-ins.

Attenuation: Eight line (2 digit BCD) attenuation control for 0-99 db. Input level TTL negative or contact closure. (connects to "multiplexer" output jack)

Programming Power Output: Plus 20V and -20V at 100 mA available for external programming.

"Unleveled" Output: Open collector trasistor saturates when any plug-in operating in the leveled mode reaches an unleveled condition. Capable of sinking 50 mA.

REMOTE OUT TO SLAVE UNIT:

From the "REMOTE IN" Jack:

- Plug-In Select
- Frequency Programming
- RF Amplitude

} (For Plug-In slots 5-8)

- FM Quieting
- Markers
- Blanking
- "Unleveled" Output

From the Leveling Amplifier:

- Leveling
- Leveling GND

PROGRAMMING OUTPUT TO MULTIPLEXER:

Plug-In Select: Eight lines from "REMOTE IN"Jack

Attenuation: Eight lines from "REMOTE IN" Jack

Power:
+20V @ 100MA
-20V @ 100MA

Leveling Input: Connects to leveling amplifier input

SPECIFICATIONS Con't

ENVIRONMENT:
Zero to +55° C, operating
Minus 55 to +85° C, non-operating
(No restrictions should block free air flow into or out of instrument)

POWER INPUT:
104, 115, 208 or 203V, ± 10%, 50-60 Hz, 300VA max.

CONSTRUCTION AND MOUNTING:
Full rack, bench mounting with tilt-up base.

Dimensions:	Height:	3 1/2"
	Width:	17"
	Depth:	19"
Weight:	29 pounds, without plug-ins	

ACCESSORIES SUPPLIED:
Phase-Lock Plugs: 4-Model 9106. Miniature plug to insert into PHASE-LOCK jacks on back of 520. Has terminals jumpered but not soldered.

Programming Plug: 1-Model 9127. Mating plug to REMOTE IN jack.

Jumper Cables: 4-Model 9114-1.6. BNC jumper cables for connecting LEVELER OUT jacks to plug-in EXT DET inputs.

OPTIONAL ACCESSORIES:
Rack Mount Adapter: Model 9020. Holds two Model 520's and one Model 522 in a rigid package for rack mounting. Supplied as a no cost option if all three instruments are ordered simultaneously.

Cabinet Adapter: Model 9021. As above, makes a single attractive 10 1/2" bench cabinet. Available as an alternate to Model 9020 if requested.

Rack Mounting Adapter: Model 9008. Adapts instrument to mount in standard 19" rack.

Interconnecting Cables:
Model 9124. For connecting Model 521 to Model 520.
Model 9122. For connecting Model 520 to Model 522.
Model 9123. For connecting two Model 520's.

RELATED INSTRUMENTS:
Multi-Band Controller: Model 521. Provides all sweeper and signal generator functions for control of up to eight 5000 Series RF Plug-Ins, mounted in two Model 520 sources.

Multiplexer: Model 522. Multiplexes eight RF inputs to a common line and provides a common leveling output signal. Digitally controls attenuation.

SECTION 2

INITIAL INSTRUCTIONS

2.1 UNPACKING AND INSPECTION UPON RECEIPT

2.1.1 The instrument is shipped in a specially constructed container (See Fig. 2-1) to provide maximum protection to the equipment during transit. Use care when unpacking to prevent damage to the equipment, such as cabinet paint finish, controls, indicators, connectors, etc.

2.1.2 Removing Contents. To remove the instrument from the shipping container, cut and fold back outer carton top flaps, remove top protective cushion, lift instrument clear from shipping container, open dust protection bag and remove equipment.

2.1.3 Inspection. (See Fig. 2-2) The instrument was carefully tested and inspected prior to shipment. Inspect the instrument for damage incurred during shipment. Check that the power cable is supplied with the instrument. If the instrument is damaged in any way, follow Shipment Damage Procedure on the last page of this manual.

2.2 PREPARATION FOR USE

2.2.1 The instrument is shipped ready for use. Required power source is 104 to 230 volts AC ± 10%, 50 to 60 Hz single phase, which can supply approximately 300 watts of power.

2.2.2 Operation from other than 115V Line. The instrument is normally shipped with the 115/230V switch in the 115V position and the jumpers on A2 set for operation from a 115 volts AC source. For operation from other sources follow the directions below:

2.2.2.1 230 Volt Operation

a. With a small screwdriver switch the 115/230V switch to the 230V position. (See paragraph 3.3.15 for location)

b. Remove the 3A fuse on the rear panel and replace with 3AG, 1 1/2A, Slo-Blo fuse.

2.2.2.2 104 Volt Operation

a. Remove bottom cover.

b. With a soldering iron, change the position of the two jumpers on A2 from the position marked 115V to the position marked 104V.

c. Replace cover

2.2.3 208 Volt Operation

a. Perform steps a, b, and c of 2.2.2.2

b. Perform steps a and b of 2.2.2.1

2.3 INSTALLING AND REMOVING PLUG-INS

2.3.1 Installing a Plug-In. To install a Plug-In unit, first remove the filler panel (if any) from the Model 520 panel, by removing the one screw in the upper right side of the plug-in. Dial is not used. Keep plastic dial available so it may be reinstalled on the Plug-In upon its removal from the Model 520. Insert the Model 5000 Series Oscillator Plug-In unit through the Model 520 front panel and lock it in position by turning the knurled knob clockwise until finger-tight. Install corresponding dial scale on Model 521 if used with 520. Dial scales for the 521 are normally provided with the unit or are available on special order.

2.3.2 Removing Plug-In. To remove a Plug-In unit from the instrument, loosen the knurled locking knob by turning it counter clock-wise. Gently remove the Plug-In unit by pulling on the locking knob. Reinstall plastic dial on right of the Oscillator Plug-In.

2.4 POWER CABLE

2.4.1 This instrument is equipped with a three-conductor power cable which, when plugged into an appropriate receptacle, grounds the instrument chassis for safety The center offset pin of the rear panel three prong line connector is the ground pin. Is is recommended that the instrument be grounded for protection of operating personnel. If used with a Model 521 Controller, it may be plugged into one of the AC outlets on the rear of that instrument.

2.4.2 To ground the chassis when operating from a two contact outlet, use a 2-prong adapter and connect the ground wire to a convenient ground point.

2.5 MOUNTING

2.5.1 Bench use. The instrument is normally supplied with rubber feet and a fold-away tilt-stand for convenient bench operation. The tilt-stand permits raising the front of the instrument so that the control markings can be read more easily.

2.5.2 The Model 520 Source can optionally be mounted in any of the following combinations:

a. By itself using the Model 9008 Rack Mounting adapter

b. With an additional Model 520 and a Model 522 Multiplexer using Model 9021 Adapter which sub-mounts the three units behind an access door in a bench mount configuration.

c. As above, using a Model 9020 for a rack mounted unit.

2.5.3 Ventilation. The Model 520 is air cooled by a fan mounted in the rear panel. The air intake holes are in the bottom and side covers of the cabinet. Air flow through these holes, should be unrestricted for adequate cooling of the instrument. Ambient air temperature should be in the rated range 0 to +55° C.

If the unit is to be rack mounted, allow for normal flow through the rack so that the ambient air temperature to the Model 520 does not exceed +55° C. If two units are mounted vertically, there are sufficient holes for adequate air flow through the sides, providing they are not covered. Operation at temperatures above 55° C ambient can cause damage.

2.5.4 Tandem Operation of Two Model 520 Units with Multiplexer Model 522 (See figure 2-2). All programming inputs to the Model 520 come from the rear-panel REMOTE IN connector. This connection also includes the plus and minus 20 volts that is available for external programming. Each Model 520 has internal wiring for connecting the inputs from the input connector to the adjacent REMOTE OUT, and MULTIPLEXER connectors. The REMOTE OUT connector is available for connecting to a second Model 520 the control voltages to plug-ins 5-8 in the second unit. Thus remote control inputs for a total of eight oscillator plug-ins are available at the REMOTE INPUT connector of the first Model 520. For tandem operation, simply connect a cable assembly* from the REMOTE OUT of the first Model 520 to the REMOTE IN of the second 520 and from the MULTILPLEXER connector to the REMOTE IN of the Model 522. Connect RF jumpers from the RF output connectors of the RF plug-ins to the input of the multiplexer. The function switch of the first 520 should read "master" and second, "slave" for proper leveling operation. Plug-In position indicator tabs on the panel of the second 520 should be turned to their reverse side to read 5, 6, 7 and 8 instead of 1, 2, 3 and 4. Small screws on these tabs can be removed to permit reversal. Except for 115/230V AC input power, which must be supplied with seperate power cords, the second Model 520 and multiplexer are ready for use.

* Each Model 520 is shipped a mating connector for the REMOTE IN jack. This may be used for connecting an external programmer. A ready made tandem connecting cable, Model 9123 may be ordered from the factory for connecting two Model 520's, Model 9124 for connecting a Model 521 to a Model 520 and Model 9122 for connecting a Model 520 to a Model 522.

2.5.5 Operation with the Model 521 Multi-Band Controller. Operation with the Model 521 controller as a multi-band sweeper system requires only four simple steps.

a. Connect the REMOTE IN connector to the Model 521, REMOTE OUT with the Model 9124 cable assembly.

b. Set up the RF plug-in panel controls as follows:

1. RF level to minimum

2. Either jumper EXT DET jack to the LEVELER

output jack of the 520 and switch the panel LEVELER switch to EXT, switch to LEVELER position for internal leveling, or switch to OFF position for unleveled operation.

3. Turn 1KHz and MARKERS off

4. Turn retrace on

5. Turn instrument AC power switch on

c. If Model 9021 or 9020 adapters are used, snap the protective cover over the front of the unit to guard against accidental control manipulation.

d. Plug the 520's and 522 into the switched outlets on the rear of the 521 controller.

2.6 REPACKING FOR SHIPMENT

2.6.1 If the Model 520 is to be repacked for shipment, use the original shipping container and packing if possible (see figure 2-1). If the original packing material has been discarded or is not in condition for reuse, repack the instrument as follows:

a. Wrap the instrument in heavy wrapping paper or plastic protective covering.

b. Place a protective cushion in the bottom of a shipping carton and place the instrument on the cushion.

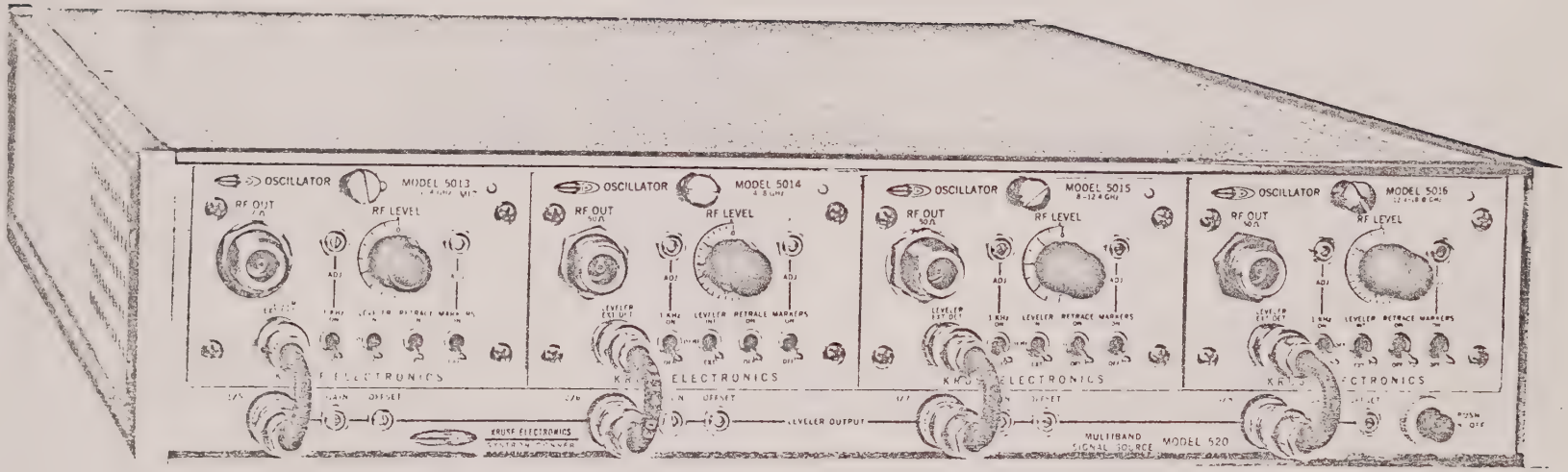
c. Surround the remaining sides and top with additional protective cushion. Place front and rear protective cushions so that they provide support for the instrument without resting on controls or indicators.

FIGURE TO BE ADDED LATER

FIGURE 2-1 PACKAGING FOR SHIPMENT

FIGURE TO BE ADDED LATER

FIGURE 2-2 FRONT AND REAR PANEL VIEWS


OSCILLATOR
MODEL 5013
RF OUT
50Ω
RF LEVEL
ADJ
LEVELER EXT OUT
1 KHz ON
LEVELER RETRACE MARKERS
OSCILLATOR
MODEL 5014
RF OUT
50Ω
RF LEVEL
ADJ
LEVELER EXT OUT
1 KHz ON
LEVELER INT
RETRACE MARKERS
OSCILLATOR
MODEL 5015
8-12.4 GHz
RF OUT
50Ω
RF LEVEL
ADJ
LEVELER EXT OUT
1 KHz ON
LEVELER INT
RETRACE MARKERS
OSCILLATOR
MODEL 5016
RF OUT
50Ω
RF LEVEL
ADJ
LEVELER EXT OUT
1 KHz ON
LEVELER INT
RETRACE MARKERS
ELECTRONICS
GAIN
OFFSET
LEVELER OUTPUT
KRUSE ELECTRONICS
MULTIBAND
SIGNAL SOURCE
MODEL 520

SECTION 3

FUNCTIONAL OPERATION CHECKS

3.1 TURN-ON PROCEDURE

3.1.1 Apply 115V AC 50-60Hz to input power connector (for operation at other line voltages, see 2.2.3).

3.1.2 Depress ON/OFF switch, a light incorporated in the ON/OFF switch should light. The fan in the rear of the instrument should run.

3.2 POWER SUPPLY CHECK

3.2.1 Check for the following voltages at any plug-in socket (a plug-in extender Model 9202 is helpful in this process)

PIN#	VOLTAGE
1, 13, 24	0 V
2	+250 V
3, 4	+30 V
5, 6	+20 V
7, 8, 9	-20 V

NOTE: The Model 520 Source is equiped with a "crowbar" type of over-current protector. If a momentary short circuit occurs or if a plug-in is installed while the power is on, the protector will shut off the +20V, +30V and -20V supplies. This condition is indicated by a reading on the +20V supply of <1V. If this occurs, shut the unit off, wait three minutes minimum and restart.

3.3 INITIAL LOGIC CHECK

3.3 Check for the following voltages at Plug-In socket #1:

PIN#	VOLTAGES
12	$\sim$ -10V
14	0 V
21	0 V
22	0 V

3.4 FUNCTIONAL CHECK

Apply the below voltages and conditions and observe the results:

a. Apply +1.5 Volts to REMOTE IN connector pin 40. Check for 1.5 Volts at REMOTE OUT connector pin 11.

b. Apply -1.5 Volts to REMOTE IN connector pin 41. Check for -1.5 Volts at REMOTE OUT connector pin 10.

c. Apply -1.5 Volts at MULTIPLEXER Socket pin 36. Check for -2.25 Volts at REMOTE OUT socket pin 36.

d. Apply +1.5 Volts to REMOTE IN connector pins 46, 47, 48 and 49 and check plug-in pin 12 in plug-in slots 1 through 4 respectively. Voltage should remain $< 0V$.

e. Connect REMOTE IN pins 1, 2, 3, 4 and 12 together and repeat d. Voltages should be +1.5V.

TABLE I

OPERATIONAL CONTROLS AND CONNECTORS

Connector/ Control	Function	Location
Push On-Off	Switches Line Power to Instrument	Front Panel
Leveler CAL (4)	Individual Output Adjustments for Leveling Loop	Front Panel
Leveler Output (4)	Individual Outputs from Leveling Amplifier	Front Panel
Mode-Master/Slave	Determines whether source of Leveling signal is MULTIPLEXER pin 36 or REMOTE IN pin 50	Rear Panel
Fuse	Slo-Blo fuse for Instrument protection 3 Amp for 115V or 1.5 Amp for 230V operation.	Rear Panel
115-230	Determines Line Voltage (See 2.2.3)	Rear Panel
Line	Input Line Connector-mates with cord supplied.	Rear Panel
Phase-Lock (4)	Normally shorted connectors mating with the phase-lock jacks provided. The phase-lock input provides either a direct connection to the oscillator tuning element for fast FM applications (normal) or a second constant sensitivity tuning input (plug-in modification M6).	Rear Panel
Remote In		Rear Panel
Pin 1	Plug-in Select #1 (Actuate by grounding)	
2	" " #2 " "	
3	" " #3 " "	
4	" " #4 " "	
5	" " #5 " "	
6	" " #6 " "	
7	" " #7 " "	
8	" " #8 " "	
9	+20V @ 100MA (max) for external programming	
10	-20V @ " "	
11	Two Seperate Ground Wires	
12		
13	NC	
14	NC	
15	Quieting Input (+ 5V for FM quieting)	
16	Unleveled Output	

Connector/ Control		Function	Location
Remote In Con't			Rear Panel
Pin	17	Frequency Tuning Input #5 (0 to -10 volts)	
	18	" " #6 " "	
	19	" " #7 " "	
	20	" " #8 " "	
	21	External AM Input #5 (0 to +2 volts)	
	22	" " #6 " "	
	23	" " #7 " "	
	24	" " #8 " "	
	25	Leveling Input Low Side (Slave Mode)	
	26	Attenuation In 1 dB (TTL Negative or Contact Closure)	
	27	" " 2 dB " " "	
	28	" " 4 dB " " "	
	29	" " 8 dB " " "	
	30	" " 10 dB " " "	
	31	" " 20 dB " " "	
	32	" " 40 dB " " "	
	33	" " 80 dB " " "	
	34	Connects To "MULTIPLEXER" Jack Pin 9	
	35	" " " 10	
	36	" " REMOTE OUT " " 5	
	37	" " " " 6	
	38	NC	
	39	NC	
	40	Blanking Input (+4 volts for blanking)	
	41	Marker Input (-1 volts for marker)	
	42	Frequency Tuning Input #1 (0 to - 10 volts)	
	43	" " #2 " "	
	44	" " #3 " "	
	45	" " #4 " "	
	46	External AM Input #1 (0 to +2 volts)	
	47	" " #2 " "	
	48	" " #3 " "	
	49	" " #4 " "	
	50	Leveling Input High Side (Slave Mode)	
Remote Out			Rear Panel
Pin	1	NC	
	2	NC	
	3	NC	
	4	NC	
	5	Connects to "REMOTE IN" Jack Pin 36	
	6	" " " Pin 37	
	7	NC	
	8	NC	

Connector/ Control		Function	Location
Remote Out Con't			Rear Panel
Pin	9	NC	
	10	Marker Output	
	11	Blanking Output	
	12	Quicting Output	
	13	Unleveled Input	
	14	Frequency Tuning Output #5	
	15	" " " #6	
	16	" " " #7	
	17	" " " #8	
	18	Leveling Amplifier Output-Low Side (0V)	
	19	Plug-In Select Output #5	
	20	" " " #6	
	21	" " " #7	
	22	" " " #8	
	23	} Two Seperate Ground Wires	
	24		
	25	NC	
	26	NC	
	27	NC	
	28	NC	
	29	NC	
	30	NC	
	31	NC	
	32	External AM Output #5	
	33	" " " #6	
	34	" " " #7	
	35	" " " #8	
	36	Leveling Amplifier Output-High Side	
Multiplexer			Rear Panel
Pin	1	Attenuation Output 1 dB	
	2	" " " 2 dB	
	3	" " " 4 dB	
	4	" " " 8 dB	
	5	" " " 10 dB	
	6	" " " 20 dB	
	7	" " " 40 dB	
	8	" " " 80 dB	
	9	Connects to "REMOTE IN" connector Pin 34	
	10	" " " " Pin 35	
	11	NC	
	12	NC	
	13	NC	
	14	NC	

Connector/ Control		Function	Location
Multiplexer Con't			
Pin	15	NC	
	16	NC	
	17	NC	
	18	NC	
	19	Plug-In Select Output #1	
	20	" " " #2	
	21	" " " #3	
	22	" " " #4	
	23	" " " #5	
	24	" " " #6	
	25	" " " #7	
	26	" " " #8	
	27	+20V @ 100MA (max)	
	28	-20V " "	
	29	0V	
	30	NC	
	31	0V	
	32	NC	
	33	NC	
	34	NC	
	35	Leveling In-Low	
	36	Leveling In-High	

SECTION 4

OPERATING INSTRUCTIONS

4.1 INTRODUCTION

The Model 520 will operate in either of two ways. The first way makes use of front panel controls of individual Plug-Ins and permits simplified programming at the expense of flexibility in AM functions. The second permits full control remotely and disables the front panel controls, but requires more complex programming. The FM programming functions are the same in either case.

4.2 FM PROGRAMMING

4.2.1 Plug-In Selection. Any one or combination of plug-ins may be selected by grounding (with a switch or saturated NPN transistor) the appropriate pin of the REMOTE IN connector. This reduces the internal attenuation of the selected plug-in from maximum to the value set by the plug-in front panel RF level control and external AM inputs. Selection is completed in less than 100 microseconds.

4.2.2 Frequency Tuning. Plug-In's may be individually tuned by applying 0 to -10 Volts to the appropriate pins of the REMOTE IN connector. -.1V to -9.9 Volts will tune any plug-in over its specified usable frequency range. Frequency is proportional to voltage within the accuracy of the plug-in itself, which typically is 1/2 of the limit stated for Frequency Accuracy on the Plug-In Specification Chart. The Model 520 has a stable, quiet, -20V supply available for frequency programming. The noise on the supply is less than 100 uV peak-to-peak, and load voltage changes are virtually negligible

4.2.3 FM Quieting. Terminal 15 on REMOTE IN connector is common to each plug-in frequency FM quieting control input. The quieting input reduces the bandwidth of the frequency control circuit from 10KHz to 2Hz. (Typical-depends on plug-in) Narrow bandwidth normally is used in CW and Manual Scan applications to reduce residual FM. Wide bandwidth is required for rapid frequency change or sweeping. A quieting control input level of zero gives 10KHz bandwidth, + 5 volts gives the 2Hz bandwidth.

4.3 SIMPLIFIED AM PROGRAMMING

4.3.1 General. All Plug-In controls operate normally as in a sweeper. No common control is provided for 1KHz, retrace blanking function, level control, etc.

4.3.2 Blanking. A common blanking input is provided to all plug-ins on terminal 40 of REMOTE IN connector. This is typically used for sweep retrace blanking, or zero setting of auxilliary equipment. The normal panel RF blanking input level is +5 volts. The blanking signal overrides the plug-in front panel RF LEVEL CONTROL and reduces its control voltage to zero so that the RF output is turned off when RF plug-in panel RETRACE switch is in OFF position. When the blanking signal is zero volts, the RF output is set by the plug-in RF LEVEL control setting.

4.3.3 Markers. Marker input on terminal 41 of REMOTE IN connector, like external amplitude modulation, blanking, and RF level control, is an amplitude modulation function. Marker signals are applied in common to all Plug-Ins whether they are ON or OFF. Those that are On will have a small reduction in the RF output amplitude during a negativ e marker pulse. The marker is normally a narrow -1 volt pulse.

4.3.4 RF Level Control. Separate voltage control of power level is provided for each plug-in for use in leveled or unleveled operation via terminals on the REMOTE IN connector. When a plug-in is in leveled operation, power control is linear and can be calibrated.

RF level control voltages sum with panel RF LEVEL control output. An external AM ten volt peak-to peak signal will control, over its full RF amplitude range, any unleveled plug-in. If a plug-in is leveled, then the power level control sensitivity is 0.1 V/mW. External RF level control signals vary RF output relative to panel RF LEVEL control setting. For example with a plug-in in unleveled mode, if the RF LEVEL control is set to zero, a 0 to +10V external AM signal will turn the RF from full OFF to full ON. A negative signal does not affect RF output. If the RF LEVEL control is at full output setting, then a 0 to -10 V signal will reduce RF output to OFF. Positive excursions will not disturb the RF output. If the RF LEVEL control is set at half-scale, a +5V input will turn the plug-in fully ON and -5V will turn it fully off (>40 dB below full output).

Similarly, a 10V pk to pk simusoidal signal (±5V peak) would result in 100% amplitude modulation. Note that the modulation would be distorted due to modulator nonlinearity. Leveled mode operation is the same except external AM sensitivity is rated at .1 V/mW. A 20 mW plug-in requires only 2 volt pk to pk to full AM over the leveled range. Greater voltage can drive the RF output to full unleveled value. When RF is blanked (see d below) output from panel RF LEVEL control is reduced to zero. External AM voltages can still control RF output in the same manner as when RF LEVEL control is at zero.

4.4 FULLY REMOTE AM PROGRAMMING

4.4.1 General. The blanking and marker circuits described above and the plug-in internal 1 KHz square wave generator all operate in such a way as to remove the internal voltage applied to the plug-in RF LEVEL control. The external AM input is unaffected. For full remote programming of AM functions, the internal circuits can be disabled as described in paragraph 2.5.5, b. The external AM lead is now the only AM programming control available, Its use is described below.

4.4.2 Power Set. In leveled mode a sensitivity of + .1 V/mW will result allowing a remote power control.

4.4.3 Blanking, Markers and Square Wave. By removing or modifying the supply voltage to the remote level control, the output may be blanked just as is done internally in the plug-in.

4.5 LEVELING

4.5.1 General. Remote leveling for up to eight plug-ins is accomplished exactly the same as for a single standard 5000 Series RF Plug-In. A detector of 10mV/mW sensitivity is connected to multiplexer pins 36 (center conductor) and 35 (signal 0V). The signal is amplified and fed to the LEVELER OUTPUT jacks through the CAL pots and to the second 520 through the REMOTE OUT .. connector.

4.5.2 Calibration. (Repeat for each plug-in) Connect the detector, jumper the LEVELER OUTPUT to the EXT DET input of the plug-in with a BNC cable. Remove any external AM input signal, or marker signal. Set the RF LEVEL control to the maximum calibrated level for that plug-in. Measure the output power and rotate the CAL control to obtain the desired output.

SECTION 5

THEORY OF OPERATION

5.1 INTRODUCTION

5.1.1 The Kruse Model 520 Source is most easily understood by dividing it into its component parts:

a. Power Supply

b. Logic Interface
Reference to Fig. 5-1, Simplified Schematic, Fig. 5-2 Power Supply Schematic, and Fig. 5-3, the complete schematic will aid in understanding the operation of the various circuits discussed.

5.2 POWER SUPPLIES

5.2.1 The three transformer powered, highly filtered, rectifier circuits supply the necessary D.C. input to the regulator circuits. The output voltages available are nominally +45, -35 and +250V. The transformer and filter capacitors are chassis mounted, the rectifiers and bleeder resistors form part of A3 and A4 (mounted inside the heatsink).

5.2.2 Regulator circuits for +20V, +30V and -20V highly regulated supplies are contained in A5. The pass transistors and current equalization resistors are mounted on A3 and A4. Over current sense circuitry is mounted partly on A3 and partly on A5.

5.2.3 A reference diode A5 CR10 is used in the + 20V regulator to achieve an extremely stable reference voltage of approximately 6.2V. This is compared in operational amplifier A5Q4 to the +20V sense input as divided down by resistor A5R10, A5R11, A5R12 and A5R13. These resistors are selected to set the exact output voltage. A5R5 supplies base drive for A5Q3 which is connected in a three stage darlington configuration with A3Q4 and A3Q1, Q2 and Q3 in parallel. A5Q4 regulates the output by "robbing" base current from A5Q3.

5.2.4 Operation of the regulation is best understood by tracing its corrective action. Assume that the output voltage drops for some reason, the + 20V sense voltage will then drop, as will the divided voltage at A5Q4, pin 2. Since this is an inverting input, the output of Q4 at pin 6 will rise, taking less of the current available from A5R5 and thus allowing more base drive to A5Q3 and hence more output.

5.2.5 The +20V sense is also applied to the -20 regulator. It is summed with the -20V sense into pin 3 of A5Q6 and compared to 0V (on pin 2). This arrangement provides for exact tracking of the supplies. Resistor A5R20, A5R21, A5R22 and A5R23 are selected to make the voltages equal. The output of A5Q6 drives a darlington output configuration consisting of A4Q6 driving A4Q4 and A4Q5 in parallel. The pass transistors are connected from the positive side of the rectifier bridge to ground. The negative bridge terminal is the

5.2.5 Con't -20 output point.

5.2.6 Operation of the -20 V regulator is similar to that of the +20 V regulator. A drop in output voltage leads to a more positive voltage at A5Q6 pin 3, since this is a non-inverting input the output raises, increasing the drive to the pass transistors, thus reducing their collector-emitter drop and raising the output voltage.

5.2.7 The + 30V Regulator also tracks the +20V supply. The + 20V sense voltage is applied to A5Q5 pin 3 and compared with the +30V sense voltage divided by A5R15, 16, 17, and 18. A5Q1 provides a constant drive to A5Q2 which is in a darlington configuration with A4Q3 and A4Q1 and Q2 in parallel. A5Q5 regulates the output by "sinking" part of the drive current to A5Q2.

5.2.8 Overcurrent protection for the positive supplies is actuated by sensing the voltage drop across A3R2, 0.1 ohm resistor. This voltage is compared in A5Q8 to a fixed voltage at pin 3. When that voltage is exceeded, Q8 flips to a positive saturated state driving A5CR3 through A5CR11 and A5R7. A5C2 provides protection against transient triggering. A5CR3 removes the base drive from all the pass transistors.

5.2.9 Overcurrent protection for the -20V supply is acuated by sensing the voltage drop from the base of A4Q6 to ground. This voltage is compared in A5Q7 to a fixed voltage at pin 2. Operation is identical to that of the positive overcurrent protection circuit.

5.3 LOGIC INTERFACE.

5.3.1 Blanking. The blanking amplifier A1Q2 is configured as a fast voltage follower with unity gain. The +5 volt blanking signal from REMOTE IN connector J13 pin 40 feeds pin 3 on Q1. The output at pin 6 feeds REMOTE OUT connector J14 pin 11 and all plug-in sockets through individual 5.6K isolating resistors.

5.3.2 Markers. The marker amplifier is identical to the blanking amplifier except that no isolating resistors are used in the output. The 0 to -1.5V pulses from REMOTE IN connector pin 41 feed Q3 pin 3. Pin 6 output feeds all plug-in sockets pin 21 and REMOTE OUT socket pin 10.

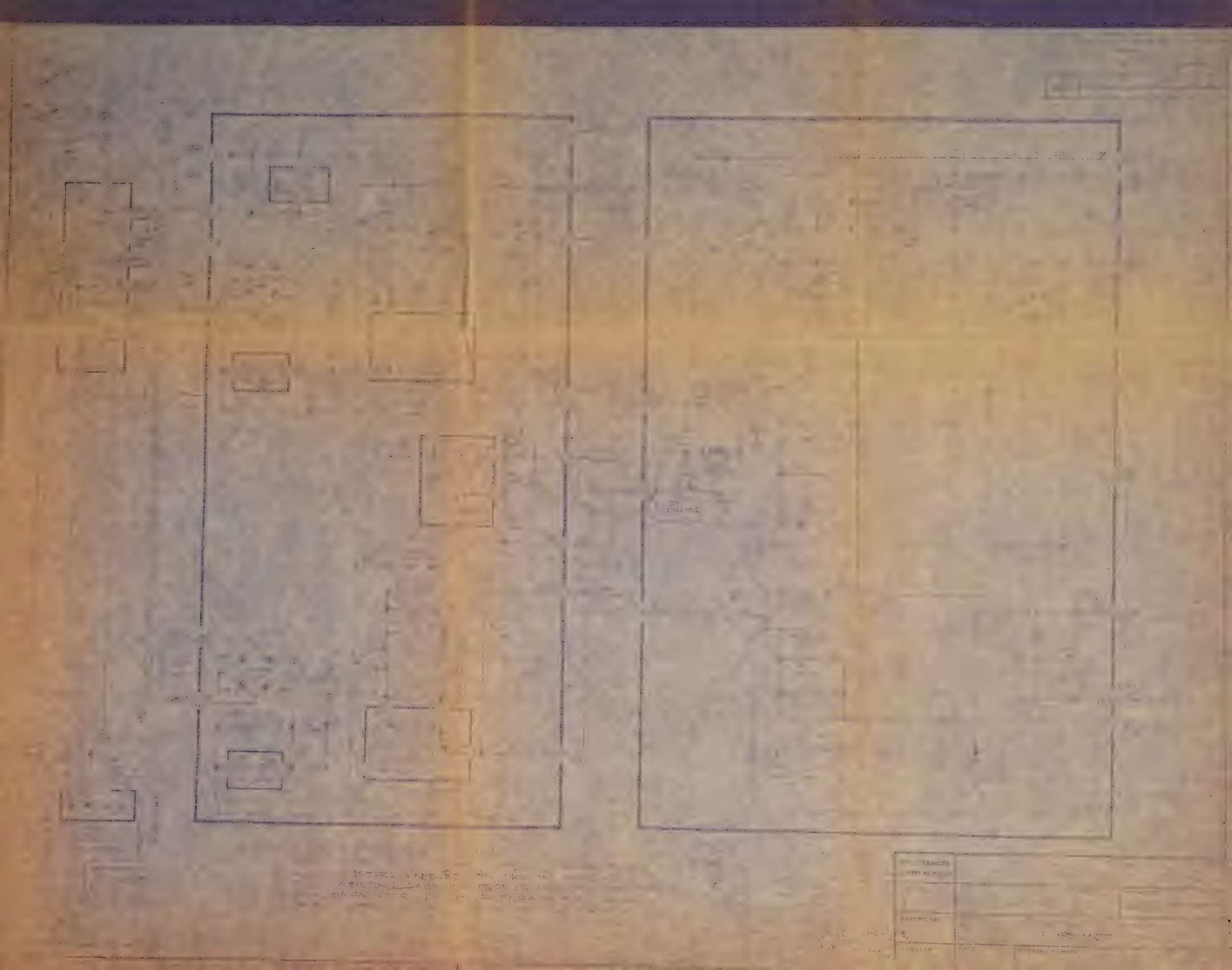
5.3.3 Leveling. The leveling amplifier A1Q1 is also connected as a voltage follower. Its input accepts from the multiplexer connector the same 10 mV/mW detector signals required by the 5000 Series plug-ins. Resistors A1R2 and A1R7 are selected for minimum D.C. offset. Individual calibration of outputs is achieved by amplifying the signal by 1.5 and then feeding the individual outputs through 10K ohm potentiometers. Since the leveling input impedence of the RF plug-ins is 5K ohm, the potentiometers act as part of a voltage divider. In slave mode the outputs are connected to the leveling amplifier in the master source through the REMOTE IN connector.

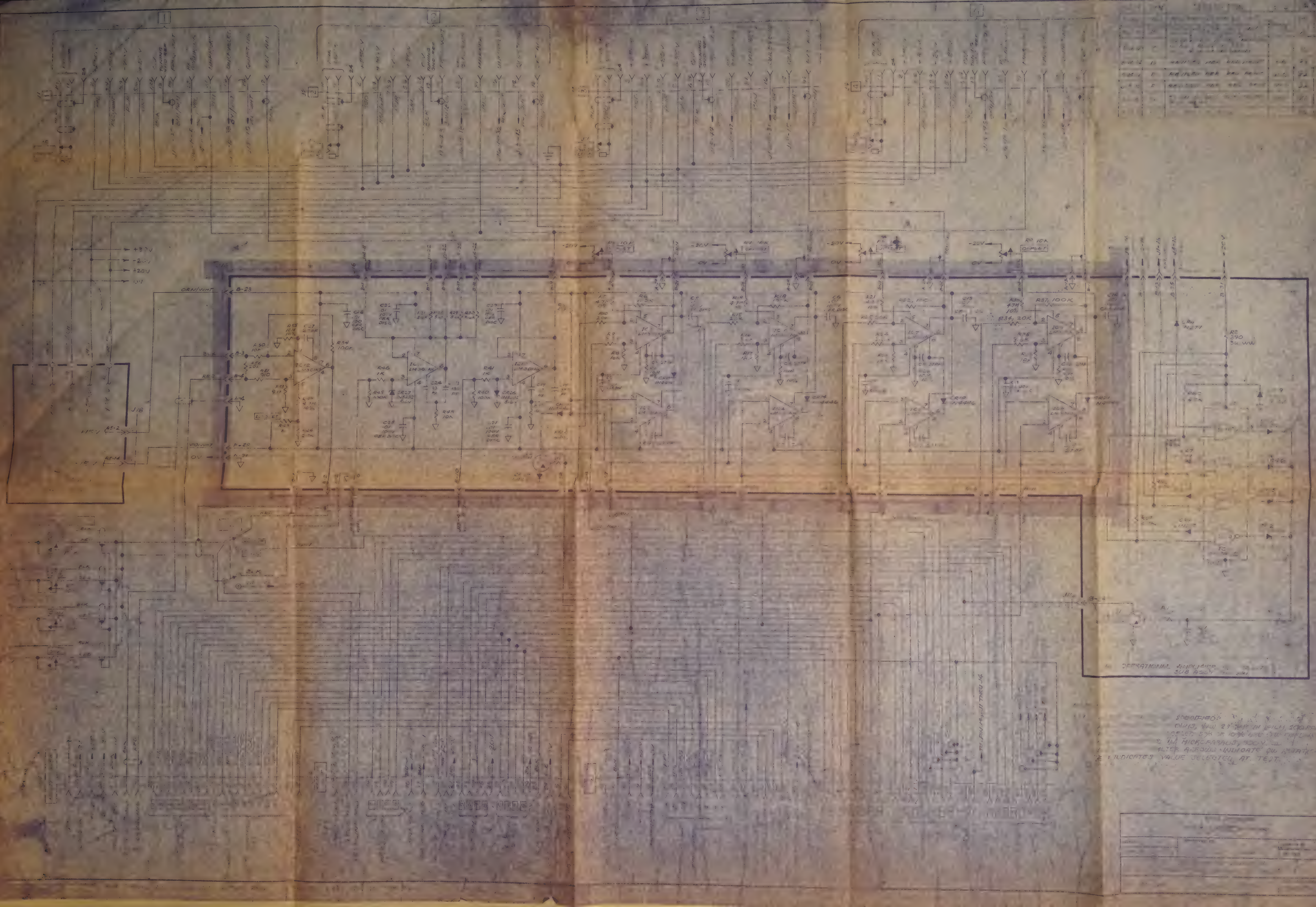
5.3.4 External AM and Plug-In Select. A1Q5, Q7, Q9 and Q10 are connected as voltage followers from the individual external AM inputs to the external AM pin 6 of the plug-ins. This operation is modified by the action of A1Q4, Q6, Q8 and Q10. Operation of this circuit can be understood by examining Q4 and Q5, the plug-in #1 external AM driver. Since the coding of plug-in select is BCD negative (or contact closure), no current will be drawn through the emitter of the Q4 if no plug-in is selected. The voltage dividing action of R25, R26, and R27 is such that a positive voltage is applied to pin 2 of the operational amplifier through the CR4, this forcing the output to be 0V for any normal external AM input by an amount sufficient to turn the RF output to zero. When current is drawn from the emitter of the transistor, the collector voltage drops sufficiently to back bias the diode and allow the voltage follower to operate normally.

5.3.5 Unleveled Indicator. A1Q13, A1Q12 and their associated components form the unleveled indicator circuit. Since plug-in select coding is TTL negative, the output of all the NOR Gates except the selected one will be a 0. When a plug-in is selected, that NOR Gate acts as a logic inverter for the signal from pin 16 of the respective plug-in. Plug-Ins which are equiped with an unleveled lamp option provide a TTL negative output signal during unleveled conditions. This is inverted by the logic gate and applied to Q12 through R54. Capacitor C24 acts as a pulse stretcher so that even if the plug-in is unleveled for a small amount of time, a reasonable length pulse comes from Q12.

FIGURE TO BE ADDED LATER

FIGURE 5-1 BLOCK DIAGRAM -520




OPERATIONAL AMPLIFIER SUB ASSY
ORN/WHT
B-23
+15V
-15V
+22V
0V
J18
IC LM301AN
IC LM308N
IC LM324
R54 100K
R46 1K
R41 1K
R49 10K
R50 10K
R37, 100K
R34, 20K
R2 390
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SECTION 6

CALIBRATION AND MAINTENANCE

6.1 GENERAL

6.1.1 The Kruse Electronics Model 520 is a permanently calibrated instrument and should give many years of trouble-free operation. Routine, simple tests can be made periodically to give assurance that the instrument is accurately calibrated and operating properly. This section of the manual describes these tests.

A Calibration Test Data Addendum is included which gives the actual test results of the initial factory calibration.

Maintenance and re-calibration procedures are included. Repairs or calibration accuracy checks should be undertaken only by qualified personnel with sufficient experience and knowledge to ensure that proper test methods are employed. Use standard maintenance practices when working on the instrument. Always turn line power off before removing PC cards, or otherwise working on the instrument. Discharge large filter capacitors before performing repairs.

6.1.2 Care should be taken in removing and replacing components to prevent damage to printed wiring, cabling and adjacent components. The use of a low-power, pencil-type soldering iron is recommended. DO NOT use a soldering gun as damaging voltages may be induced into solid-state components.

6.2 PREVENTATIVE MAINTENANCE

6.2.1 The Model 520 Source is a permanently calibrated instrument requiring no periodic maintenance when operated in a normal laboratory anvoronment. For more severe environmental use, it is recommended that the instrument be periodically inspected and cleaned, as follows:

a. The top, bottom and side covers should be removed and any accumulated dust or foreign material removed with a soft brush and low-pressure dry air.

b. Contact fingers of plug-in PC cards may be cleaned with a gum eraser to insure good contact.

c. Inspect for loose screws, nuts, controls, etc. and tighten as required.

6.3 CALIBRATION

6.3.1 The Model 520 is permanently calibrated at the factory by the selection

6.3.1 Con't of fixed components. No calibration adjustments are provided or required. Only a component failure can cause degradation in performance.

6.3.2 Factory test data for the instrument serial number shown are included in Addendum I. The test procedures outlined in paragraph 6.3.4 through 6.3.9 were used to test and calibrate the instrument at the factory. The paragraph numbers shown on Addendum I correspond to paragraph numbers in the test procedures below. It is recommended that these procedures and the test data be used as a guide for checking instrument performance.

6.3.3 For a complete check-out of the Model 520 Source the following test equipment is required:

a. Digital Voltmeter (DVM) with 0.01% accuracy and 0.1 mV resolution (Systron-Donner Model 7000 or equivalent).

b. Oscilloscope with calibrated vertical sensitivity of 10 μV/cm, selectable bandwidth and calibrated time base (Tektronix 543A with 1A7A plug-in, or equivalent).

c. Standard "D" flashlight cell or other fully floating 1.5V power supply

6.3.4 Preliminary Statements

a. TESTS SHOULD BE PERFORMED IN THE SEQUENCE GIVEN IF CALIBRATION ADJUSTMENTS ARE REQUIRED.

b. ALL TESTS SHOULD BE PERFORMED WITH THE OSCILLATOR PLUG-IN REMOVED.

(See Section 3 (Figures 3-1 and 3-2) for location of controls and connectors.)

6.3.5 +20 Volt Power Supply

a. Turn the line power on. With the DVM measure the voltage between plug-in #3 socket, pin 5 and pin 13. The voltage should be +20 ± .02V (obtained by selecting the value of A5R10 and/or A5R12).

b. Vary AC line voltage plus and minus 10% and measure voltage change with the DVM. The voltage change should be less than ± .002 volts (regulation .01%).

c. Connect the oscilloscope to the same points and measure ripple. Use 1Hz to 30KHz bandwidth. Ripple should be less than 300 μ V peak-to-peak.

6.3.6 -20 Volt Power Supply

a. With the DVM, measure the voltage between plug-in socket #3 pin 8 and pin 13. The voltage should be -20 ± .02V (obtained by selecting A5R21 and/or A5R23).

6.3.7 +30 Volt Power Supply

a. With the DVM measure the voltage between plug-in socket #3 pin 4 and pin 13. The voltage should be +30 ± .1V (obtained by selecting A5R15 and/or A5R17).

6.3.8 Leveling Amplifier

a. Switch rear panel MODE switch to MASTER and short MULTIPLEXER jack pins 35 and 36 together.

b. With the DVM measure the voltage at any of the LEVELER OUTPUT jacks. The voltage should be less than plus or minus 2 mV (obtained by selecting A3R2 and/or A3R7).

6.3.9 Marker Amplifier

a. Apply -1.5 volts between REMOTE IN connector pin 41 and pin 11 (0V)

b. With the DVM measure the voltage between plug-in #3 socket pin 21 and pin 13 (0V). The voltage should measure approximately -1.5V.

6.3.10 Blanking Amplifier

a. Apply +1.5V between REMOTE IN connector pin 40 and pin 11 (0V)

b. With the DVM veasure the voltage between plug-in #3 pin 22 and pin 13 (0V). The voltage should measure approximately +1.5V.

6.3.11 Unleveled Lamp Circuit

a. Apply +1.5V through a 1 K ohm resistor to REMOTE IN connector pin 16. Short plug-in socket #3 pin 16 to pin 13.

b. With the DVM measure the voltage from REMOTE IN connector pin 16 to pin 11 (0V). The voltage should measure less than 1 volt.

6.3.12 External AM/Plug-In Select Circuit

a. Apply +1.5V to REMOTE IN connector pins 46, 47, 48 and 49. Check all plug-in sockets' pin 12. The voltage should be less than 0V (typically -10V).

b. Short REMOTE IN pins 1, 2, 3, 4 and 11 together and recheck the voltage at plug-in sockets' pin 12. The voltage should approximately be +1.5V.

SECTION 7

MAINTENANCE AND REPAIR

7.1 The Model 520 Multi-Band Source is a carefully engineered device and only qualified electronic maintenance personnel should execute repairs.

The previous section has given a comprehensive circuit description for the unit's operation and most failures that can occur will be easily identifiable as to which block of the system has failed and standard trouble shooting techniques should quickly isolate the problem.

7.1.1 The following table of possible failures and the appropriate corrective steps may be a help or guide to the repair technician in case of an operation failure.

7.2 POWER SUPPLIES

Step	Symptom	Check (replace if faulty)	Diagnosis and Suggested Action	
			If Negative	If Positive
1	Blown Fuse	Remove all Plug-Ins check for excessive current draw.	One plug-in has shorted, check all D.C. input points of plug-in particularly +250V (Pin 2)	Replace fuse & plug-ins and go on to Step 2
2	"	Check for presence of +250V output at Pin 2 of oscillator plug-in sockets.	Check for wiring shorts, check C1 the +250V filter capacitor, CR1 the +250V rectifier. Check for opens, shorts or case shorts in the +250V winding.	Go to step 3
3	"	Check +20V, +30V and -20V outputs	LO: Check for shorted A5CR3 failed OP Amp A5Q4, A5Q5 A5Q6, A5Q7, A5Q8. HI: Check all pass transistors in A3 and A4 and Drivers A5Q2 and A5Q3. Check for open SCR A5CR3, failed OP Amp A5Q7, A5Q8.	Disconnect all secondary transformer leads & Check

Step	Symptom	Check (replace if faulty)	Diagnosis and Suggested Action	
			If Negative	If Positive
4	Low regulated Voltages (All)	A5CR3, OP Amp A5Q7 and Q8 Resistor A3R2.	Over current circuit OK- One circuit is overloaded.	Replace failed components
5	+30V output Low	OP Amp A5Q5, Driver A5Q2, resistors A4R3 and A4R5	Regulator circuit OK-check pass transistor for opens	Replace Failed Components
6	+30V output High-others OK	Pass transistors A4Q1, Q2 and Q3 and driver A5Q2.	Regulator- check 30V sense lead	"
7	-20V output LO, others OK	Unregulated voltage across C3 for LO or no voltage.	Check A4Q4, Q5 and driver A4Q6. OP Amp A5Q6 resistors A4R8 and A4R10	Check C3, A4CR5, CR6, CR7 and CR8 transformer voltage.

7.2.1 LOGIC INTERFACE

Step	Symptom	Check (replace if faulty)	Diagnosis and Suggested Action	
			If Negative	If Positive
1	RF output from non-selected plug-in	A8Q4, Q5, Q6 and Q7. A1Q8, Q9, Q10 and Q11.	Check for shorts from plug-in. Select pins of REMOTE IN connector to ground	REPLACE
2	No RF output selected plug-in	Same As Above	Check plug-in select input for opens	REPLACE
3	No leveling signal from Leveler output jacks	A1Q1 position of mode switch.	Check Leveler Input	REPLACE
4	No Blanking Output	A1Q2	Check for wiring short from J14 pin 11 to ground	REPLACE

Step	Symptom	Check (replace if faulty)	Diagnosis and Suggested Action	
			If Negative	If Positive
5	No Marker Output	A1Q3	Check for short from J14 pin 10 to ground	REPLACE
6	Unleveled Indicator function not operating properly	Plug-in to see that it is operating in leveled mode and has internal connection to Pin 16.	Plug-in is not equipped to operate circuit	Check A1Q13 and Q12.

Model 520
Serial No. _____

CALIBRATION TEST DATA

ADDENDUM I

(Refer to corresponding paragraph numbers in Section 6 of the Instruction Manual for detailed procedures)

6.3.5a +20V output = _____V (+20 ± .02V)
Value A5R10 _____ ohm. Value A5R12 _____ ohm.

6.3.5b Regulation, 10% line voltage change (103 to 127V) _____%
(< .01 %)

6.3.5c Ripple on +20V supply _____μV (< 300μ V)

6.3.6a -20V output = _____V (-20 ± .02V)

6.3.7a +30V output = _____V (+30 ± .1V)

6.3.8b LEVELING AMPLIFIER OFFSET _____mV (< ± 2)

6.3.9b MARKER AMPLIFIER FUNCTIONAL _____ (Check)

6.3.10b BLANKING AMPLIFIER FUNCTIONAL _____ (Check)

6.3.11b UNLEVELED LAMP CIRCUIT FUNCTIONAL _____ (Check)

6.3.12a NON-SELECT CIRCUIT FUNCTIONAL _____ (Check) Plug-In #1
_____ (Check) Plug-In #2
_____ (Check) Plug-In #3
_____ (Check) Plug-In #4

6.3.12b EXTERNAL AM CIRCUIT FUNCTIONAL _____ (Check) Plug-In #1
_____ (Check) Plug-In #2
_____ (Check) Plug-In #3
_____ (Check) Plug-In #4

MP MASTER
MA33954